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ABSTRACT

A study involving 80 undergraduate students was undertaken to test the use of imaginal and verbal strategies to remember and comprehend concrete and abstract prose passages. Sets of three to five words were selected from each passage. After reading a passage, the subjects were instructed to process the words either verbally or imaginally by writing a series of sentences or by drawing a picture. In a second session, the subjects were given two tests: a multiple choice test to measure the subject's understanding of the relationship between elements of each word set, and a production test to test the subject's production of the relationships between the study words. The results showed that on the multiple-choice tests the verbal strategy was better than the imaginal strategy, and the effect of the concreteness of the passage and the interaction between concreteness and strategy were not significant. On the production test, there was a trend in favor of the verbal strategy, the effect of concreteness was significant, and the interaction between concreteness and strategy was not significant. (TJ)

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Technical Report No. 110

THE EFFECTS OF IMAGINAL AND VERBAL STRATEGIES ON PROSE COMPREHENSION IN ADULTS

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Abstract

Adult subjects were given concrete and abstract textbook passages to study by using either an imaginal or verbal strategy. Two days later, they were given a multiple-choice test and a production test of comprehension. The verbal strategy produced better comprehension than the imaginal strategy; concrete passages were comprehended better than abstract passages, but only according to the production test; and strategy and concreteness did not interact. Differences between these results and results obtained in imagery research on word lists are discussed, and caution is advised before generalizing the word research to meaningful prose learning by adults.

Imagery and Prose Comprehension by Adults

The effectiveness of imagery for facilitating recall of word lists has been amply documented (e.g., Paivio, 1969, 1971). In general, concrete words are remembered better than abstract, and when subjects are instructed to use imagery as a mnemonic strategy, they often remember more words than when they use other strategies, especially rote repetition. Moreover, these effects of concreteness and strategy have been shown to interact. Paivio and Foth (1970) showed that for concrete words, an imaginal strategy produces better recall than a verbal mediational strategy, whereas for abstract words, the verbal strategy is better than the imaginal. This interaction is important theoretically because it provides support for distinguishing between an imaginal system of representation specialized for concrete materials and a verbal system specialized for abstract materials--a distinction compatible with Paivio's dual-coding view of memory (e.g., Kieras, 1978; Paivio, 1971). The dual-coding view has been questioned, however, and it has been contrasted with the view that all of long-term memory can be represented in terms of abstract propositions. The logic of these views has been explored in a number of recent discussions (Anderson, 1978; Kieras, 1978; Kosslyn & Pomerantz, 1977; Paivio, 1974; Pylyshyn, 1973).

The dual-coding view is not restricted to the representation of words in experiments on list-learning, and so it is meaningful to ask whether the results of Paivio and Foth generalize to prose learning as well. An interaction between concreteness and strategy when prose materials are used would

support the generality of the dual-coding view; the absence of an interaction would raise questions about dual-coding as it applies to prose and would increase the need for an alternate approach to memory representation for prose learning.

Other research on imagery effects in prose learning has concentrated mainly on children (e.g., Pressley, 1977), whereas the main concern in the present study was learning by adults. Of the few studies investigating imagery in adult learning of extended prose, two measured recall of words rather than comprehension (Montague & Carter, 1973; Yuille & Paivio, 1969). Anderson and Kulhavy (1972), on the other hand, used test items intended to assess learning of specific and general information. Overall, they found no difference in learning between subjects instructed to use imagery and subjects instructed merely to read carefully. However, when subjects in the control and experimental conditions were questioned as to how often imagery was actually used while reading, it was found that learning benefitted from imagery. De Villiers (1974) used several measures of recall and found that sentence learning was positively correlated with concreteness but only when the sentences were <u>not</u> processed as a connected story. In light of the small amount of imagery research on adults' meaningful learning from extended prose, it seems worthwhile to pursue this topic further, as was done in the present study.

The present study was a test of the generality of the concreteness-strategy interaction (Paivio & Foth, 1970) as well as a test of the main effects of concreteness and strategy.

The study is best viewed as a direct application of the Paivio and Foth (1970) paradigm to natural language discourse. In the original study, subjects were presented with abstract word pairs or concrete word pairs and, depending upon which strategy was cued, were asked to apply either an imaginal mediator or a verbal mediator to connect the two words. To ensure that subjects were indeed processing the words in the imaginal system, subjects were instructed to draw their "image" on paper. For the verbal mediator condition, subjects were asked to write a sentence connecting the two words.

In the present study, subjects applied either an imaginal or verbal study strategy to sets of words taken from abstract and concrete passages. Subjects first read a passage and then applied the assigned strategy. For the imaginal strategy, subjects were instructed to draw a picture which would show how the words were related. For the verbal strategy, subjects were instructed to write a few sentences to explain the relationships. The instructions were intended to ensure that subjects actually used the processing strategies. Thus the present study employed procedures as close as possible to those of Paivio and Foth, with modifications necessary for application to natural discourse. Because sentence comprehensibility has been confounded with concreteness in some past research (Johnson, Bransford, Nyberg & Cleary, 1972; Johnson, 1974; Moeser, 1974), care was taken here to ensure that comprehensibility was controlled across the concrete and abstract passages.

Two comprehension tests were selected to assess the subjects' learning and retention after a two-day interval. A multiple choice comprehension test was constructed according to guidelines set by Anderson (1972), and a production test was constructed where subjects were presented with the word sets and were asked to explain the relationships among the words.

Method

Design

A mixed factorial design was used to test the effects of strategy type (imaginal vs. verbal) and concreteness of passage (abstract vs. concrete). Strategy type was a between-subjects variable and concreteness was a within-subjects variable.

Subjects

The subjects in this experiment were undergraduate students in psychology courses at Illinois State University. They received extra-credit points for participating. In total, 57 females and 23 males participated. These subjects were different from those who generated the normative data. The subjects were assigned randomly to the strategy conditions, and they were run in groups of 15 to 20.

Materials

Normative data were obtained on the concreteness and comprehensibility of several passages. Initially, three passages that seemed relatively abstract and three passages that seemed relatively concrete were selected from textbooks on mammalogy and archaeology (Gorenstein, 1965; Van Gelder, 1969).

These textbooks were selected on the basis of their presumed low familiarity to college freshmen and sophomores. Thirty-nine college students rated the individual paragraphs in the passages for concreteness and for comprehensibility on seven-point scales. For the concreteness ratings subjects were instructed to rate each paragraph in each passage according to the degree to which it referred to tangible objects that could be easily pictured or imagined. For the comprehensibility ratings, comprehensibility was defined as the ease with which a paragraph could be understood with one reading. Or each of the scales, the mean rating by each subject for each passage was computed. The means were subjected to analysis of variance and Newman-Keuls tests for both concreteness and comprehensibility. On the basis of these analyses two pairs of passages were selected, each passage about 1400 words in length. The pairs differed from each other in concreteness ($p < .05$), although the individual passages were not significantly different within each pair. The mean concreteness ratings for the four respective passages were: 3.24, 3.58, 4.74, 5.10. (Higher numbers indicate higher concreteness.) The passages were not significantly different from each other in comprehensibility. The mean comprehensibility ratings for the four respective passages were: 4.84, 4.75, 5.11, and 4.96. (Higher numbers indicate higher comprehensibility.) Thus, the normative data allowed us to distinguish concrete from abstract passages, with comprehensibility controlled. The final set of passages included two from the mammalogy textbook (a concrete passage on physical adaptations and an abstract passage on population genetics) and two from the archaeology textbook (a concrete passage on the

effects of the physical environment on artifacts and an abstract passage on the relation of archaeology to other disciplines).

Sets of study words (3 to 5 words per set) were selected from each passage. The word sets contained words which were related in some way. Generally, the words were instances of concepts; e.g., dolphin, whale, and otter were all instances of mammals which swim in a particular manner. There were 5 to 8 sets of words for each passage. Examples are given in the Appendix.

Instructions

The strategies were implemented by asking the subjects to process the study word sets either verbally or imaginally. In both cases, the study words were presented with the passages, and subjects received the following instructions:

> For each set of words identify the concept described in the text which relates them to one another. That is, determine how the things or ideas named by the words are related according to the information given in the text.

Subjects in the imaginal strategy group were additionally told to draw a picture which incorporated these things or ideas in a scene depicting their relationship. Subjects in the verbal strategy group were told to express the relationship by using the words in a sentence or two.

Tests

Two tests were given to each subject: a multiple choice test and a production test.

The multiple-choice test attempted to measure the subject's understanding of the relationships between elements of each word set. Questions were written to meet Anderson's (1972) paraphrase requirement for comprehension items whenever possible. All questions had four alternative answers. The position of the correct answer was determined randomly except for the constraint that correct answers appear in each position equally often. There were 8 to 13 questions for each passage. Examples are given in the Appendix.

The second test was designed to test subjects' production of the relationships between the study words. The word sets which had been presented during the study phase were presented again for the test, and subjects were asked to explain in a few sentences how the words in each set were related to each other.

Procedure

Each of the subjects participated in two sessions. During the first, they studied a concrete passage and an abstract passage, and during the second, they took the two tests. Four different combinations of abstract-concrete passage pairs were formed from the two concrete and the two abstract passages. These passage sets along with instructions for one of the study methods were randomly assigned to subjects as they were seated in the classroom. Half of the subjects read the abstract passage first and the other half, the concrete passage.

At the outset of the first session subjects were given written instructions, whether for the imaginal or verbal strategies. They were also given

an example passage and a set of study words which were different from the upcoming materials. The imaginal strategy group was given a picture depicting the relations among the study words, and the verbal strategy group was given a few sentences which explained the same relation.

All subjects were given 10 minutes to read the first passage and then 5 minutes to apply the study method to each of the word sets for that passage. Each study set was accompanied by a number indicating the paragraph in which the words initially occurred. After a break, the procedure was repeated with the second passage. Two days later all subjects returned for the multiple-choice and production tests.

Results

The proportion of correct choices on the multiple-choice test was calculated for each subject, and the means of these proportions appear in Table 1. A three-point scale was used to score the production test: 0 was assigned to responses which expressed an incorrect relationship between the words; 1 was assigned if the relationship reported was inadequately explained or if it was close but not exactly the relationship intended by the author; and 2 was assigned if the relationship reported matched the one described in the text. The means of these scores are presented in Table 2, expressed as portions of the maximum possible score.

Insert Tables 1 and 2 about here

Analysis of variance for the multiple-choice tests and for the production tests support the following conclusions. For the multiple-choice tests, there was a significant effect of strategy; $F(1,76) = 4.11$, $p < .05$, where the verbal strategy was better than the imaginal strategy. Neither the effect of concreteness nor the interaction between concreteness and strategy was significant; F's < 1. For the production test, there was a strong but non-significant trend in favor of the verbal strategy; $F(1,76) = 3.41$, $p < .07$. The effect of concreteness was clearly significant; $F(1,76) = 24.82$, $p < .001$. The interaction between concreteness and strategy was not significant; $F < 1$. Taken together, the results indicate an effect of strategy in which the verbal strategy is superior to the imaginal, an effect of concreteness for the production test alone, and no interaction between strategy and concreteness.

Discussion

The results of this study prevent a simple extension of imagery effects in word list research to the area of learning from prose. Whereas Paivio and Foth (1970) found that the difference between imaginal and verbal strategies reversed when concrete rather than abstract words were the test materials, no such reversal was found here. Instead, the verbal strategy produced generally better performance than the imaginal. The difference between verbal and imaginal strategies was larger for the abstract passage, but the interaction was not significant. The general superiority of the verbal strategy suggests that the subjects' representation of the passages was closer to a verbal form (possibly abstract rather than word-based) as

opposed to an imaginal form, even for the passages that were concrete. Further, the solidly established superiority of concrete over abstract materials in word list research was not obtained in the multiple choice test but only in the production test. This result may be due to the larger element of retrieval in production. The effect of concreteness is often attributed partly to a facilitation of retrieval (e.g., Just & Brownell, 1974; Paivio, 1969), and if this is assumed, it is reasonable that the production test would show an effect of concreteness whereas the multiple-choice test would not. Still, multiple-choice tests of the kind used here are recognized as valid tests of comprehension (Anderson, 1972). Thus, the present results indicate that one cannot generally expect concreteness to facilitate comprehension as measured in this way. This limitation on the effect of concreteness taken together with the general superiority of the verbal over the imaginal strategy indicate caution before anticipating that the powerful imagery effects established in word list research will extend to meaningful prose learning by adults.

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Table 1

Results for the Multiple-Choice Tests

	Concreteness		
Strategy	Abstract	Concrete	Mean
Verbal	.664	.665	.665
Imaginal	.577	.612	.595
Mean	.621	.639	

Table 2

Results for the Production Tests

	Concreteness		
Strategy	Abstract	Concrete	Mean
Verbal	.414	.556	.485
Imaginal	.286	.476	.381
Mean	.350	.516	

Appendix

Examples of word sets and corresponding multiple-choice questions.

1. Beaver, Muskrat, Round-Tailed Water Rat

   the beaver, muskrat, and round-tailed water rat

   A. are alike in that they have the same kind of tail and swim by kicking their hind feet one at a time

   *B. are dissimilar in the shape of their tails even though they are used for similar purposes

   C. are alike in that they have the same kind of tail but dissimilar as to method of swimming

   C. have nothing in common other than being rodents in water environments

2. Roman literature, Greek literature, the Bible

   Which of the following stimulated interest in early archaeology?

   A. Talmud, Bible, Greek literature

   *B. Roman literature, Greek literature, Bible

   C. Talmud, Mishna, Koran

   D. Roman literature, Bible, Koran

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